

**Title:**

"The Role of Materials Degradation and Analysis in the Space Shuttle Columbia Accident Investigation"

**Abstract:**

The efforts following the loss of the Space Shuttle Columbia included debris recovery, reconstruction, and analysis. The debris was subjected to myriad quantitative and semi-quantitative chemical analysis techniques, ranging from examination via the scanning electron microscope (SEM) with energy dispersive spectrometer (EDS) to X-Ray diffraction (XRD) and electron probe micro-analysis (EPMA). The results from the work with the debris helped the investigators determine the location where a breach likely occurred in the leading edge of the left wing during lift off of the Orbiter from the Kennedy Space Center. Likewise, the information evidenced by the debris was also crucial in ascertaining the path of impinging plasma flow once it had breached the wing. After the Columbia Accident Investigation Board (CAIB) issued its findings, the major portion of the investigation was concluded. However, additional work remained to be done on many pieces of debris from portions of the Orbiter which were not directly related to the initial impact during ascent. This subsequent work was not only performed in the laboratory, but was also performed with portable equipment, including examination via portable X-Ray fluorescence (XRF) and Fourier transform infrared spectroscopy (FTIR). Likewise, acetate and silicon-rubber replicas of various fracture surfaces were obtained for later macroscopic and fractographic examination. This paper will detail the efforts and findings from the initial investigation, as well as present results obtained by the later examination and analysis of debris from the Orbiter including its windows, bulkhead structures, and other components which had not been examined during the primary investigation.